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EXAMINER	
TRAN, KHANH C	
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Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 10/03)

H'A

Office Action Summary	Application No.	Applicant(s)	
	09/785,366	BETTS, WILLIAM L.	
	Examiner	Art Unit	
	Khanh Tran	2631	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *26 May 2005*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,3-5,7-12,14,16-18,20-29,31-40,42-52,54-64 and 66-91* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,3-5,7-12,14,16-18,20-29,31-40,42-52,54-64 and 66-91* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *02/16/2001* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application (PTO-152)

6) ☐ Other: _____.

DETAILED ACTION

1. The Amendment filed on 05/26/2005 has been entered. Claims 1, 3-5, 7-12, 14, 16-18, 20-29, 31-40, 42-52, 54-64 and 66-91 are pending in this Office action.

Response to Arguments

2. The objection of the Drawings has been withdrawn after Applicant cancelled claim 13.

3. Applicant's arguments filed on have been fully considered but they are not persuasive. Below are the rejection previously presented in the last Office action in addition to Examiner's responses to Applicant's arguments filed on 05/26/2005.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 1, 7-9, 11-12, 14, 20-22, 24-26, 31-33, 35-36, 40, 42-43, 47-48, 52, 54-55, 59-60, 64, 66-67, 71-82 and 87 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lin et al. U.S. Patent 6,553,063 B1.

Regarding claim 1, Lin et al. invention is directed to an apparatus and method for communicating information using fractional bit-per-symbol signaling rates responsive to communication channel conditions. In column 3 lines 25-41, Lin et al. discloses a general inventive concept in figure 1 that illustrates a communication device 1. The communication device 1 includes data transformer 4 and controller 5, wherein the communication device 1 can be representative of a transmitter, a receiver, or both, see column 1 lines 50-52. Figure 2 shows a more detailed embodiment of a transmitter 11 (or transceiver 11), and figure 3 shows a detailed embodiment of a receiver 24 (or transceiver 24). In column 1, lines 45-60, Lin et al. further teaches the devices that embody the present invention, ***can include a transmitter, a receiver, or both***. In light of the foregoing teachings, the transmitter in figures 2 4 are transceiver and the receiver in figures 3 6 are transceiver also.

(a) Lin et al. invention does not expressly teach the *claimed step of "receiving information associated with a destination transceiver, the information relating to a plurality of signal space constellation points supported by the destination transceiver".*

In column 3 lines 42-65, according to Lin et al. invention, column 3 lines 41-65, the predetermined integer number of data bits contained in a transmission symbol is selectable, responsive to the channel condition. It is desirable that the

channel condition to which controller 5 responds, and by which the selectable predetermined number of data bits is selected and processed by data transformer 4, is a preselected channel condition metric. Desirable metrics for the representation of channel condition include the signal-to-noise ratio of the *received symbol* and/or the power of the noise in *a received symbol*. In column 6, lines 45-65, see also figure 4, Lin et al. further teaches that ***constellation selection controller 49 chooses the desired constellation size based on the number of bits to be transmitted via the transmission symbol at hand***. In column 8, lines 35-55, ***tables 80 of receiver 75 typically correspond to similar constellation tables in transmitter 90***. In light of the aforementioned disclosure, the receiver 75 supports the signal space constellation points. Still in column 8, lines 35-55, constellation selection controller 49 in figure 4, constellation selection controller 82 can inform demodulator 76, sequence estimator 78, demapper 79, and parallel-to-serial converter 81 of ***the pertinent details of the constellation being implemented at a particular moment, such as the current symbol alphabet and the number of bits in recovered symbol 86***.

Conclusion from the aforementioned discussion:

- The predetermined integer number of data bits contained in a transmission is selectable, responsive to channel condition.
- The received information carries the pertinent details of the constellation being implemented at a particular moment, such as the current symbol

alphabet and the number of bits in recovered symbol 86, which is directly related to the desired constellation size supported by the destination transceiver.

- Constellation tables 80 of receiver 75 typically correspond to similar constellation tables in transmitter 90. As result of that, any desired both transmitter and receiver support constellation size selected from the constellation tables.
- Transmitter or receiver can be a transceiver according to Lin et al. invention and any transceiver in Lin et al. invention can be designated as a destination transceiver.
- The foregoing discussion addresses Applicant's arguments on pages 21-24 of the Remark related to the claimed limitations "*receiving information associated with the destination transceiver, the information relating to a plurality of signal space constellation points supported by the destination transceiver*".

b) As recited above, based on channel condition metrics, constellation selection controller 18 in figure 2 selects a predetermined integer number of data bits per bit vector, see column 4 lines 4-14. In column 5 lines 6-35, Lin et al. gives examples to show ratio of the integer number of bits and the plurality of symbols being a non-integer. In the first example, the data bit rate is 7.073 data bits per transmitted symbol. To achieve the desired 7.073 data bits per transmitted

symbol, bit parser 13 of figure 2 can selectively and adaptively partition the stream of incoming data bits into seven seven-bit data bit vectors, and one eight-bit data vector, each of the data bit vectors being grouped as a transmission symbol, see column 5 lines 23-35. In light of the foregoing, the bit parser is functionally equivalent to a fractional encoder, for encoding an integer number of bits into a plurality of symbols as claimed in the instant application.

c) Referring to figure 2, the constellation table contains signal space constellation points corresponding to plurality of analog symbols as appreciated by one of ordinary skill in the art. The encoder and constellation mapper 17 of the in figure 2 maps transmission symbols into the analog symbols corresponding to the signal space constellation points.

Lin et al. does not expressly teach the claimed limitation "*<u>the information associated with the destination transceiver comprises a first look-up table and the encoding an integer number of bits into a plurality of symbols involves the first look-up table</u>*".

Nevertheless, as taught by Lin et al. teachings in column 3, lines 40-65, the selection of the selectable *<u>predetermined integer number of data bits</u>* in a transmission symbol can be governed by the controller 5 in figure 1. In light of the foregoing discussion, it would have been obvious for one of ordinary skill in the art at the time of the invention that one can modify Lin et al. selection controller 5 to implement a lookup table to store those *<u>predetermined integer number of data</u>*

<u>*bits*</u>. The motivation is according to Lin et al. teachings, the integer number of data bits is predetermined and as result of that, the predetermined integer number of data bits is stored in the controller 5. As recited above, the received information carries the pertinent details of the constellation being implemented at a particular moment, such as the current symbol alphabet and the number of bits in recovered symbol 86, which is directly related to the desired constellation size supported by the destination transceiver. In view of that, the receiving information comprises a first lookup table, in which the bit parser 41 (see figure 4) uses the selected predetermined integer number of data bits to selectively and adaptively partition the stream of incoming data bits, e.g. into seven seven-bit data bit vectors, and one eight-bit data vector, each of the data bit vectors being grouped as a transmission symbol.

Regarding claim 7, the constellation table 16 in figure 2, including signal space constellation points, and would correspond to the claimed second look-up table as appreciated by one of ordinary skill in the art. In column 4 lines 1-14, the constellation selection controller 18 governs the selection of the selectable predetermined integer number of data bits in a transmission symbol. The encoder and constellation mapper 17 maps plurality of transmit symbols into plurality of analog symbols using signal space constellation points in the constellation table 16.

Regarding claim 8, in column 3 lines 60-65, Lin et al. expresses that channel state monitoring (i.e. channel conditions) is continuous, and that selection of the selectable predetermined integer number of data bits used to form a transmission symbol is adaptive to a present condition of the data channel. In light of that, the foregoing disclosure is equivalent to an encoding algorithm, and the encoding an integer number of data bits into transmission symbols is performed adaptively using the encoding algorithm, as claimed in the instant application.

Regarding claim 9, as disclosed in column 2 lines 44-51, a forward error correction code (FEC) with proper code rate can be added such that the information bit rate could further be adapted to a signal constellation size that is an integer or a power-of-two. Hence, the encoding of each of plurality of symbols into one of a plurality of analog symbol corresponding to the signal space constellation points, as taught in Lin et al., can be based on the output of a FEC code device as appreciated by one of ordinary skill in the art.

Regarding claim 11, figure 3 illustrates a receiver 24 for receiving transmitted symbols as an input data stream 25, the receiver 24 corresponds to the destination transmitter as claimed in the instant application. The input data stream corresponds to the claimed plurality of analog symbol.

Regarding claim 12, Lin et al. does not expressly teach providing the plurality of analog symbols corresponding to the signal space constellation points to the destination transceiver via a DSL as claimed in the instant application.

In column 8 lines 60-65, Lin et al. expresses the principles of the invention can also be applied to the design of modems for use in data communications. Hence, the transmitter and receiver in figures 2 and 3 can be part of two modems communicates with each other. The concept of using symbol constellations, trellis coding, fractional coding, QAM modulation is well known in the art of digital radio and voice band modem art, see column 1 lines 30-43. Therefore, it would have been obvious for one of ordinary skill in the art that Lin et al. invention can be applied to modem arts, and transmission of the plurality of analog symbols corresponding to the signal space constellation points can be implemented through a DSL line as claimed in the instant application.

Regarding claim 14, said claim claims means for performing the steps of the method in claim 1. Hence, claim 14 is rejected on the same ground as for claim 1.

Furthermore, as recited in claim 1, the device 1 in figure 1 can include both transmitter and receiver. Master controller 8 is operably connected to a corresponding receiver. In a transceiver case, master controller 8 can be part of the receiving section. The receiving section is a means for receiving information associated with a destination receiver.

As recited in claim 1, bit parser 13 of figure 2 is equivalent to a fractional encoder for encoding an integer number of bits into a plurality of symbols as claimed in the instant application.

The encoder and constellation mapper 17 in figure 2 encodes each symbol into one of a plurality of analog symbols using the constellation table 16. Hence, encoder and constellation mapper 17 performs function of the claimed means of encoding.

Conclusion: the foregoing discussion addresses Applicant's arguments on pages 25-28 of the Remark.

Regarding claim 20, said claim has similar scope as for claim 7, hence, is rejected on the same ground as for claim 7.

Regarding claim 21, said claim has similar scope as for claim 8, hence, is rejected on the same ground as for claim 8.

Regarding claim 22, said claim has similar scope of claim 9, hence, is rejected on the same ground as for claim 9.

Regarding claim 24, in addition to the rejection argument of claim 11, referring to figure 2, transmitter 11 transmits analog symbols to a receiver. Hence, transmitter 11 corresponds to the claimed means for providing the plurality of analog symbols.

Regarding claim 25, said claim has similar scope as for claim 12, hence, is rejected on the same ground as for claim 12.

Regarding claim 26, claim 26 is rejected on the same ground as for claim 1 because of similar scope. In addition to that, as recited in claim 1, the device 1 in figure 1 can include both transmitter and receiver.

- In column 3 lines 59-65, master controller 8 may be operably connected to a corresponding receiver. Channel state monitoring is continuous, and that selection of the selectable predetermined integer number of data bits used form a transmission symbol is adaptive to a present condition of the data channel. As appreciated by one of ordinary skill in the art, in case of the device 1 being a transceiver, master controller 8 can be part of the receiver, which monitors channel state continuously from received symbols associated with another transceiver.
- In column 5 lines 6-35, the bit parser 13 (see figure 2) can selectively and adaptively partition the stream of incoming data bits 10 into k data bit vectors, and k+1 data bit vector (k is an integer number), wherein each of data bit vectors is grouped as a transmission symbol. In view of that, the bit parser 13 performs function of the claimed fractional encoder to encode the integer number of bits into plurality of transmit symbols.

- The encoder and constellation mapper 17 encodes and maps each of transmit symbols into each of analog symbols corresponding to the signal space constellation points specified in the constellation table 16.
- The transmitter 11 inherently includes a transmitting portion to transmit analog symbols to the destination transceiver.

Conclusion: the foregoing teachings address Applicant's arguments on pages 29-32 of the Remark.

Regarding claim 31, claim 31 is rejected on the same ground as for claim 7 because of similar scope.

Regarding claim 32, said claim has similar scope as for claim 8, hence, is rejected on the same ground as for claim 8. As recited in claim 27, the bit parser 13 can selectively and adaptively partition the stream of incoming data bits 10 into k data bit vectors, and k+1 data bit vector (k is an integer number), wherein each of data bit vectors is grouped as a transmission symbol. In view of that, the bit parser 13 performs a function of the claimed fractional encoder to encode the integer number of bits into plurality of transmit symbols.

Regarding claim 33, said claim has similar scope as for claim 9, hence, is rejected on the same ground as for claim 9. As recited in claim 26, the encoder and constellation mapper 17 encodes and maps each of transmit symbols into each of

analog symbols corresponding to the signal space constellation points specified in the constellation table 16.

Regarding claim 35, said claim is rejected on the same ground as for claim 12 because of similar scope.

Regarding claim 36, as recited in claim 1, communication device 1 includes both transmitter and receiver, e.g. transmitter in figure 4 and receiver in figure 3.

- As recited in claim 1, the transmitter 11 computes performance metrics including S/N ratio of the ***received symbols*** and/or power of the noise *in a received symbol* to determine which constellation is to be used for communicating information using fractional bits-per-symbol signaling rates; see also column 1, lines 45-67.
- The receiver 24 in figure 3 receives transmission symbols carried upon the received signal 25. The transmission symbols correspond to the signal space constellation. As described in claim 17 of Lin et al. invention, see column 10 line 63 through column 11 line 5, the communication device is a receiver, the transmission symbol is representative of a plurality of symbol constellations, the data transformer extracts the selectable predetermined integer number of data bits thereby, the predetermined data bit rate is one of non-power of

two and a non-integer, corresponding to fractional bit rate as claimed in the instant application.

- In column 7 line 25 via column 8 line 55, see also figure 6, Lin et al. teaches the operation of a receiver in another embodiment.. A demodulator 76 demodulates the received signal 84. A sequence estimator 78 determines recovered data symbols 86, which are received by demapper 79 and, in con junction with constellation tables 80, maps a recovered symbol 86 onto data bit vector 87. Constellation selection controller 82 informs demodulator 76, sequence estimator 78, demapper 79, and parallel-to-serial converter 81 of the pertinent details of the constellation being implemented at that moment.

- Lin et al. does not expressly teach the claimed limitation "*the information comprises a first look-up table adapted to enable the source transceiver to encode an integer number of bits into a plurality of symbols, wherein the ratio of the integer number of bits into a plurality of symbols conforms to the fractional value of the fractional bit rate*".

- Nevertheless, as taught by Lin et al. teachings in column 3, lines 40-65, the selection of the selectable *predetermined integer number of data bits* in a transmission symbol can be governed by the controller 5 in figure 1. In light of the foregoing discussion, it would have been obvious for one of ordinary skill in the art at the time of the invention that one can modify Lin et al. selection controller 5 to implement a lookup table to store those

predetermined integer number of data bits. The motivation is according to Lin et al. teachings, the integer number of data bits is predetermined and as result of that, the predetermined integer number of data bits is stored in the controller 5. As also recited in claim 1, the received information carries the pertinent details of the constellation being implemented at a particular moment, such as the current symbol alphabet and the number of bits in recovered symbol 86, which is directly related to the desired constellation size supported by the destination transceiver. In view of that, the receiving information comprises information about a first lookup table, in which the bit parser 41 (see figure 4) uses the selected predetermined integer number of data bits to selectively and adaptively partition the stream of incoming data bits, e.g. into seven seven-bit data bit vectors, and one eight-bit data vector, each of the data bit vectors being grouped as a transmission symbol; see column 5, lines 15-35.

Conclusion: the aforementioned discussion addresses Applicant's arguments on pages 33-36 in the Remark.

Regarding claim 40, as recited in claim 1, the signal to noise ratio of the *received symbol* is used to determine channel condition metrics. The information comprises a number of signal space constellation points associated with the other transceiver.

Regarding claim 42, claim 42 is rejected on the same ground as for claim 20 because of similar scope.

Regarding claim 43, said claim has similar scope as for claim 8, hence, is rejected on the same ground as for claim 8.

Regarding claim 47, as recited in claim 1, the transmitter 40 in figure 4 includes a receiver. In column 6, lines 47-67, constellation selection controller 49 can govern the selection between selectable predetermined integer numbers of data bits, e.g., k and k+1 data bits, in bit vector 43 from bit parser 41, such that the average transmitted bits per symbol 50 is k and p/q 41 e.g., 3.25). Controller 49 also can direct the trellis code encoder 45, or constellation mapper 47, or both, to *choose the desired constellation size based on the number of bits to be transmitted via the transmission symbol at hand*. Furthermore, in column 8, lines 25-55, see also figure 6, constellation tables 80 typically corresponds to similar constellation tables in transmitter 90. In light of that, the desired constellation size based on the number of bits to be transmitted via the transmission symbol corresponds to the claimed limitation "*maximum number of signal space constellation points capable of being supported by the destination transceiver and the communication channel*".

In column 5 lines 50-55, in an example, Lin et al. teaches two power-of-two signal constellations can be used, the first, smaller signal constellation

accommodating eight-bit transmission symbols; the second, larger signal constellation accommodating eight-bit transmission symbols. The resulting predetermined data bit rate is about 8.250 data bits per transmitted symbol (k=8, p=2, q=8), easily accommodating the desired 8.198 data bits per transmitted symbol. The smaller and larger signal constellations provide information associated with maximum number of signal space constellations to a source transceiver as claimed.

Lin et al. does not expressly teach receiving a plurality of analog symbols on the communication channel, each of the plurality of analog symbols corresponding to the signal space constellation points and one of the maximum number of signal space constellation points as claimed in the application claim.

In column 8, lines 25-55, constellation selection controller 82 can inform demodulator 76, sequence estimator 78, demapper 79, and parallel-to-serial converter 81 of the pertinent details of the constellation being implemented at a particular moment, such as the current symbol alphabet and the number of bits in recovered symbol 86. As also recited above, the smaller and larger signal constellations provide resulting predetermined data bit rate of 8.250 data bits per transmitted symbol. Therefore, it would have been obvious for one of ordinary skill in the art at the time of the invention the received information would provide the plurality of analog symbols on the communication channel and one of the maximum number of signal space constellation points as claimed.

In column 7 line 25 via column 8 line 55, see also figure 6, Lin et al. teaches the operation of a receiver in another embodiment. A demodulator 76 demodulates the received signal 84. A sequence estimator 78 determines recovered data symbols 86, which are received by demapper 79 and, in con junction with constellation tables 80, maps a recovered symbol 86 onto data bit vector 87. Constellation selection controller 82 informs demodulator 76, sequence estimator 78, demapper 79, and parallel-to-serial converter 81 of the pertinent details of the constellation being implemented at that moment. The pertinent details of the constellation would provide information of fractional bit rate associated with the maximum number of signal space constellation points.

Regarding claim 48, claim 48 is rejected on the same ground as for claim 36 because of similar scope.

Conclusion: the aforementioned discussion addresses Applicant's arguments on pages 36-40 in the Remarks.

Regarding claim 52, said claim has similar scope as for claim 40, hence, is rejected on the same ground as for claim 40.

Regarding claim 54, said claim has similar scope as for claim 42, hence, is rejected on the same ground as for claim 42.

Regarding claim 55, said claim has similar scope as for claim 43, hence, is rejected on the same ground as for claim 43.

Regarding claim 59, said claim has similar scope as for claim 59, hence, is rejected on the same ground as for claim 47.

Regarding claim 60, said claim has similar scope as for claim 48, hence, is rejected on the same ground as for claim 48. In this case, because the data transformer extracts the selectable predetermined integer number of data bits thereby, the predetermined data bit rate is one of non-power of two and a non-integer, it would have been obvious for one of ordinary skill in the art that the data transformer performs equivalent function of the claimed fractional decoder.

Lin et al. does not expressly teach the claimed limitation "*the information comprises a first look-up table adapted to enable the source transceiver to encode an integer number of bits into a plurality of symbols, wherein the ratio of the integer number of bits into a plurality of symbols conforms to the fractional value of the fractional bit rate*".

Nevertheless, as taught by Lin et al. teachings in column 3, lines 40-65, the selection of the selectable *predetermined integer number of data bits* in a transmission symbol can be governed by the controller 5 in figure 1. In light of the foregoing discussion, it would have been obvious for one of ordinary skill in the art at the time of the invention that one can modify Lin et al. selection controller 5

to implement a lookup table to store those *predetermined integer number of data bits*. The motivation is according to Lin et al. teachings, the integer number of data bits is predetermined and as result of that, the predetermined integer number of data bits is stored in the controller 5. As also recited in claim 1, the received information carries the pertinent details of the constellation being implemented at a particular moment, such as the current symbol alphabet and the number of bits in recovered symbol 86, which is directly related to the desired constellation size supported by the destination transceiver. In view of that, the receiving information comprises information about a first lookup table, in which the bit parser 41 (see figure 4) uses the selected predetermined integer number of data bits to selectively and adaptively partition the stream of incoming data bits, e.g. into seven seven-bit data bit vectors, and one eight-bit data vector, each of the data bit vectors being grouped as a transmission symbol; see column 5, lines 15-35.

Regarding claim 64, said claim has similar scope as for claim 52, hence, is rejected on the same ground as for claim 52.

Regarding claim 66, claim 66 is rejected on the same ground as for claim 54 because of similar scope.

Regarding claim 67, said claim has similar scope as for claim 55, hence, is rejected on the same ground as for claim 55.

Regarding claim 71, Lin et al. invention can utilize QAM constellations (see column 9 lines 1-14). As known in the art, PAM is one dimension extension of QAM. By impressing two separate k-bit symbols from the information sequence on two Quadrature carriers. The resulting modulation technique is called Quadrature PAM or QAM. Therefore, Lin et al. teachings encompass PAM modulation. Hence, it would have been obvious for one of ordinary skill in the art at the time the invention was made that Lin et al. teachings can apply to PAM modulation, wherein the signal space constellation points correspond to PAM levels.

Regarding claim 72, as shown in example 1, see column 5 lines 17-35, to achieve 7.073 data bits per symbol, a signal constellation of at least $2^{7.073}$ is required. Consequently, that number of signal apace constellation points are not equal to a power of 2.

Regarding claim 73, said claim has similar scope as for claim 71, hence, is rejected on the same ground as for claim 71.

Regarding claim 74, said claim has similar scope as for claim 72, hence, is rejected on the same ground as for claim 72.

Regarding claim 75, using analogous reasoning as for claim 71, with PAM modulation system, the signal space constellation points correspond to PAM levels, and the encoder and constellation mapper 17 in figure 2 corresponds to PAM mapper, respectively.

Regarding claims 76, 79 and 81, said claims have similar scope as for claim 72, hence, is rejected on the same ground as for claim 72.

Regarding claims 77-78 and 80, using analogous reasoning as for claim 75, claims 77-78 are rejected on the same ground as for claim 75.

Regarding claims 82 and 87, said claims have similar scope as for claim 77, hence, is rejected on the same ground as for claim 77.

Regarding claim 87, said claim has similar scope as for claim 77, hence, is rejected on the same ground as for claim 77

5. Claims 3-4, 16-17, 27-28, 37-38, 44-45, 49-50, 56-57, 61-62, 68-69, 83-84 and 88-89 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lin et al. U.S. Patent 6,553,063 B1 and Wei U.S. Patent 5,559,561 as applied to claims 1, 14, 26, 36, 43, 47-48, 59-60 and 67 above, and further in view of Williams et al. U.S. Patent 5,995,548.

Regarding claim 3, Lin et al. does not teach the encoding an integer number of bits into a plurality of symbols involves modulus conversion. In another US Patent, Williams et al. invention provides a combined frame mapping technique that uses aspects of Minimum Modulus Conversion (MMC) and Shell Mapping (SM) to map data bits to a sequence of data symbols. As expressed in the invention, see column 9 lines 15-30, Multiple Modulus Conversion is a method of converting blocks of binary data to a corresponding block of M-ary symbols to maximize the data rate while minimizing the required signal-to-noise ratio (SNR) to achieve a desired error rate. <u>*A consequence of using MMC is that it allows a non-integer number of bits to be mapped to each symbol, which increases efficiency because the constellation sizes are not restricted to powers of two (i.e., a fractional number of bits/symbol are allowed)*</u>. In view of the foregoing disclosure, Williams et al. teaches a method of Minimum Modulus Conversion (MMC) and Shell Mapping (SM) which is well suited in systems using fractional bit rate encoding. Because the method maximizes the data rate while minimizing the required signal-to-noise ratio (SNR) to achieve a desired error rate, it would have been obvious for one of ordinary skill in the art at the time the invention was made that Lin et al. transmitter can be modified to implement the method of Minimum Modulus Conversion (MMC) and Shell Mapping (SM) as taught by Williams et al.. The motivation is to minimize the required signal-to-noise ratio (SNR) to achieve a desired error rate while maximizing the data rate. The aforementioned benefits are always desirable in communication systems. Williams et al. method futher allows for tight constellation

packing and constellation balancing, so that minimum number of constellation points are required for a given bit capacity, see column 9 lines 20-25.

Regarding claim 4, Lin et al. does not teach the encoding an integer number of bits into a plurality of symbols involves shell mapping. However, the method of shell mapping is also taught in Williams et al. invention, and is discussed in claim 3 above. Hence, claim 4 is rejected on the same ground as for claim 3.

Regarding claim 16, said claim has similar scope as for claim 3, hence, is rejected on the same ground as for claim 3.

Regarding claim 17, said claim has similar scope as for claim 4, hence, is rejected on the same ground as for claim 4.

Regarding claim 27, said claim has similar scope as for claim 3, hence, is rejected on the same ground as for claim 3. Referring to figure 2, the bit parser 13 can selectively and adaptively partition the stream of incoming data bits 10 into k data bit vectors, and k+1 data bit vector (k is an integer number), wherein each of data bit vectors is grouped as a transmission symbol. In view of that, the bit parser 13 performs a function of the claimed fractional encoder to encode the integer number of bits into plurality of transmit symbols.

Regarding claim 28, said claim has similar scope as for claim 4, hence, is rejected on the same ground as for claim 4. As recited in claim 27, the bit parser 13 can selectively and adaptively partition the stream of incoming data bits 10 into k data bit vectors, and k+1 data bit vector (k is an integer number), wherein each of data bit vectors is grouped as a transmission symbol. In view of that, the bit parser 13 performs a function of the claimed fractional encoder to encode the integer number of bits into plurality of transmit symbols.

Regarding claim 37, in addition to the rejection of claim 3, Williams et al. discloses a combined frame mapping technique that uses aspects of Minimum Modulus Conversion (MMC) and Shell Mapping (SM) to map data bits to a sequence of data symbols. As disclosed in column 12 lines 8-19, the receiver has a choice to select either mapping scheme. For the MMC scheme, the decoding the received symbols involves modulus conversion.

Regarding claim 38, similar to the rejection argument of claim 37, for the shell-mapping scheme, the decoding the received symbols involves shell mapping.

Regarding claim 44, said claim has similar scope as for claim 3, hence, is rejected on the same ground as for claim 3.

Regarding claim 45, said claim has similar scope as for claim 4, hence, is rejected on the same ground as for claim 4.

Regarding claims 49, 83 and 88, said claims have similar scope as for claim 37, hence, is rejected on the same ground as for claim 37.

Regarding claims 50, 84 and 89, said claims have similar scope as for claim 38, hence, is rejected on the same ground as for claim 38.

Regarding claim 56, said claim has similar scope as for claim 44, hence, is rejected on the same ground as for claim 44.

Regarding claim 57, said claim has similar scope as for claim 45, hence, is rejected on the same ground as for claim 45.

Regarding claim 61, said claim has similar scope as for claim 49, hence, is rejected on the same ground as for claim 49.

Regarding claim 62, said claim has similar scope as for claim 50, hence, is rejected on the same ground as for claim 50.

Regarding claim 68, said claim has similar scope as for claim 56, hence, is rejected on the same ground as for claim 56.

Regarding claim 69, said claim has similar scope as for claim 57, hence, is rejected on the same ground as for claim 57.

6. Claims 5, 18, 29, 39, 46, 51, 58, 63, 70, 85 and 90 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lin et al. U.S. Patent 6,553,063 B1 and Wei U.S. Patent 5,559,561 as applied to claims 1, 14, 26, 43, 47-48 and 59 above, and further in view of Brownlie et al. U.S. Patent 5,493,586.

Regarding claim 5, Lin et al. does not teach the encoding an integer number of bits into a plurality of symbols involves constellation switching. However, as described in another US Patent, Brownlie et al. discloses in the Abstract a data transmission using Quadrature amplitude modulation to select for transmission symbols from two (or more) different signal point constellations; constellation switch being used to facilitate transmission of non-integral average number of bits per symbol, i.e. fractional bit rates. In column 3 lines 45-55, Brownlie et al. further expresses that the use of two constellations, rather than a single constellation, provides the flexibility not provided by a single constellation to enable operation over the range of data rates. It also provides flexibility on selection of the symbol rate, which may be chosen so as to maximize utilization of the available channel bandwidth while enabling standard data rates. Because of flexibility on selection of the symbol rate in the application of fractional bit

rate encoding, it would have been obvious for one of ordinary skill in the art at the time the invention was made that Lin et al. transmitter in figure 2 can be modified to implement from two (or more) different signal point constellations for constellation switching as taught by Brownie et al.. The motivation is the flexibility on selection of the symbol rate to maximize utilization of the available channel bandwidth, especially for communications system utilizing fractional bit rate encoding.

Regarding claim 18, said claim has similar scope as for claim 5, hence, is rejected on the same ground as for claim 5.

Regarding claim 29, said claim has similar scope as for claim 5, hence, is rejected on the same ground as for claim 5. As recited in claim 27, the bit parser 13 can selectively and adaptively partition the stream of incoming data bits 10 into k data bit vectors, and k+1 data bit vector (k is an integer number), wherein each of data bit vectors is grouped as a transmission symbol. In view of that, the bit parser 13 performs a function of the claimed fractional encoder to encode the integer number of bits into plurality of transmit symbols.

Regarding claim 39, Brownie et al. discloses a method for transmitting data symbols utilizing constellation switching to provide flexibility on selection of the symbol rate to maximize utilization of the available channel bandwidth. Brownie et al., however, does not disclose a receiver for decoding the plurality of analog symbols involving

constellation switching. Nevertheless, because Brownie et al. teachings apply to systems capable of transmitting fractional bits rate, Lin et al. teachings can be modified to implement constellation switching as discussed in claim 5. Lin et al. invention teaches both a transmitter and receiver, capable of transmitting and receiving fractional bit rate. If the transmitter is modified to utilize constellation switching, it would have been obvious for one of ordinary skill in the art that the decoding at the receiver would involve constellation switching.

Regarding claim 46, said claim has similar scope as for claim 5, hence, is rejected on the same ground as for claim 5.

Regarding claims 51, 85 and 90, said claims have similar scope as for claim 39, hence, is rejected on the same ground as for claim 39.

Regarding claim 58, said claim has similar scope as for claim 46, hence, is rejected on the same ground as for claim 46.

Regarding claim 63, said claim has similar scope as for claim 51, hence, is rejected on the same ground as for claim 51.

Regarding claim 70, said claim has similar scope as for claim 58, hence, is rejected on the same ground as for claim 58.

7. Claims 10, 23, 34, 86 and 91 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lin et al. U.S. Patent 6,553,063 B1 and Wei U.S. Patent 5,559,561 as applied to claims 1, 14, 26, 47 and 59 above, and further in view of Eyuboglu et al. U.S. Patent 5,214,672 B1.

Regarding claim 10, Lin et al. does not teach the step of applying each of the plurality of analog symbols to a gain scalar. Eyuboglu et al. discusses in Background of the Invention in another US Patent, which relates to trellis precoding for fractional bits/baud that the QAM constellation is scaled to have the same minimum distance between adjacent points. As known in the art, constellation scaling is normally performed in a communications system for having constellations with equal probability and equal minimum distance, therefore, one of ordinary skill in the art would have been motivated to modify Lin et al. teachings to apply a gain scalar to each of analog symbols corresponding to the signal space constellation points.

Regarding claim 23, gain scaling is usually performed after constellation mapping by a scaler. Lin et al. and Eyuboglu et al. do not explicitly show that. Nevertheless, one of ordinary skill in the art would have been motivated to implement a scaler for performing gain scaling because it is desirable to have equal probable constellation points.

Regarding claims 34, 86 and 91, said claims have similar scope as for claim 10, hence, is rejected on the same ground as for claim 10.

Conclusion

8. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Khanh Tran whose telephone number is 571-272-3007. The examiner can normally be reached on Monday - Friday from 08:00 AM - 05:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mohammad Ghayour can be reached on 571-272-3021. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

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KCT Khanh cong Tran 08/01/2005

Examiner KHANH TRAN